NASA Ground Networks

overview, architecture
&
capabilities

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Ground Network (GN) overview

GN is customer driven

- Provides ground-based space communications for NASA missions
- Provides reliable services to meet customer requirements

GN evolution goal is to provide best value service

- Manage costs to avoid large capitalization
- Maintain minimum GN Project civil servant staffing
- Balance long-term stability and flexibility of ground network capacity
- Maintain high performance and reduce risk

GN Project Overview	
Enterprise	Earth Science
Program Executive	Bill Watson, NASA HQ
Project Manager	Roger Clason, GSFC
Lead Center	Goddard Space Flight Center (GSFC)
Performing Centers	GSFC, Wallops Flight Facility
Program Type	Space Communications Services
Authority	Space Communications MOA approved by NASA Enterprises September 2002

Ground Network description

GN Customer Diversity Examples				
Organizations	Phases	Orbits/Trajectories	Frequency	Service Needs

• **NASA**
• **Other Government**
• **International**
• **Commercial**
	• **Launch**
	• **Early Orbit**
	• **On-orbit**
	• **Disposal**
		• **LEO Polar**
		• **LEO low-inclination**
		• **GEO**
		• **Launch**
		• **Sub-orbital**
			• **X-Band**
			• **S-Band**
			• **L-Band**
			• **VHF**
			• **UHF**
			• **C-band**
				• **Telemetry**
				  •Housekeeping
				  •Science Data
				• **Commanding**
				• **Tracking**
				• **Range support**
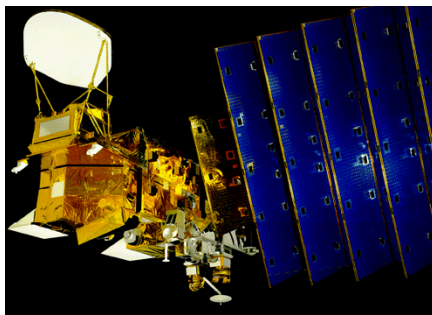
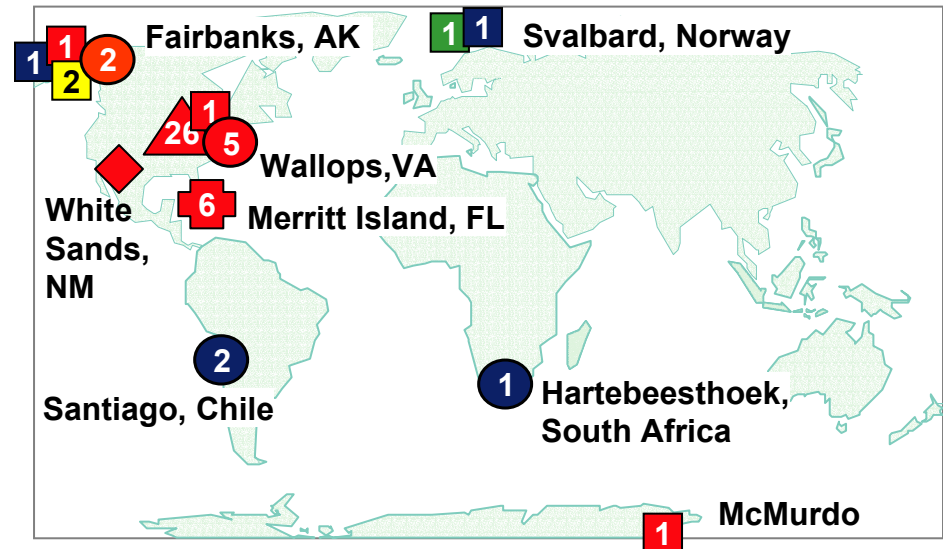**EOS Aqua**

Shuttle Launch

Ultra Long Duration Balloon

The GN has developed into a complex heterogeneous system

- **50 ground station antennas; 30 unique antenna systems**

- **7 geographic antenna locations**

- **4 different owner/operator models**

- **Numerous IDIQ contracts for additional commercial services as needed**

- **Scheduling of all NASA orbital support antennas performed from one location**

GN Antenna Map (Number of Antennas)

Fairbanks, AK
1 1 Svalbard, Norway
1 1 2 2
1 1
26 5
White Sands, NM
6 Wallops, VA
Merritt Island, FL

2
Santiago, Chile
1 Hartebeesthoek, South Africa

1 McMurdo

Primary Support Category

- ◯ Orbital S-Band
- ▢ Orbital X-Band
- △ Range
- ⬡ Shuttle
- ◇ Scheduling

Owner/Operator Model

- # NASA/CSOC
- # NASA/university
- # NASA/commercial
- # Commercial

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Customer trends and GN planning

❑ **Future customer need predicted to change**

- GN S-band missions "flying out" with few new customers in short term
- X-band requirement through 2010 for Earth Observing System (EOS)
- Other mid-term high-rate missions planning to use other networks

❑ **GN usage level uncertain beyond ~2007**

- Far-term mission plans not yet developed
- Potential for large fluctuations due to possible constellations

❑ **GN cannot afford overcapacity**

❑ **Must obtain flexibility in capacity**
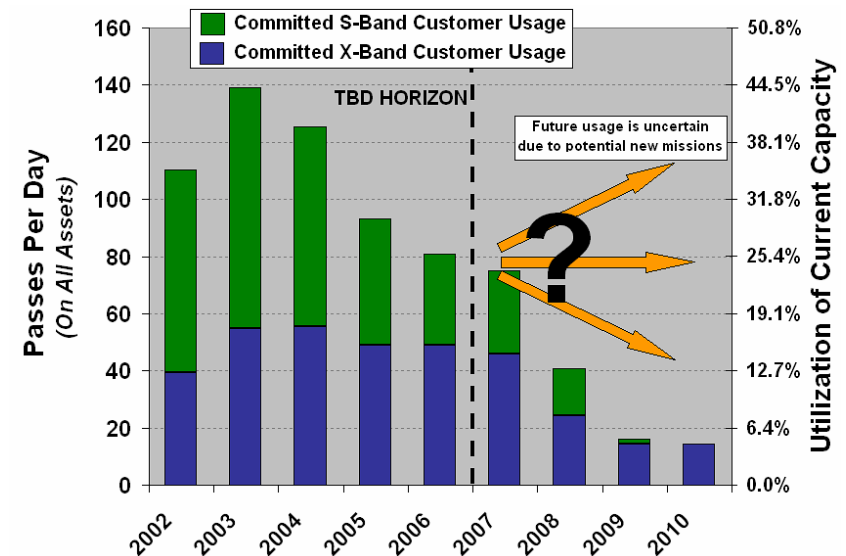
GN Currently has Capacity to Support:

More than 275 passes/day on NASA owned antennas

40 passes/day minimum on commercial contracts

Community trends may enable opportunities for coordination

❑ **NASA**

Shared support between NASA Space Network and GN will probably increase

Some overlap in functionality between GN and DSN on Earth-orbit support

❑ **NOAA**

Ample X- and S- band contingency capacity

SafetyNet (NPOESS Ka-band architecture) planned to be operational in 2009

❑ **DoD**

Exploring interoperability with other government satellite control systems

Exploring Transformational Communications for the long term

❑ **Commercial**

Some providers maintain business viability in niche markets

Other providers rely on NASA as their cornerstone customer while they seek to

develop a broader market

❑ **Partners**

Some NASA missions will continue to receive ground network services from

University and International partners

Ground Networks - Svalbard, Norway

Ground Network orbital customers

P - Prime support, B - backup

Committed ▨ Extended ☐ Potential
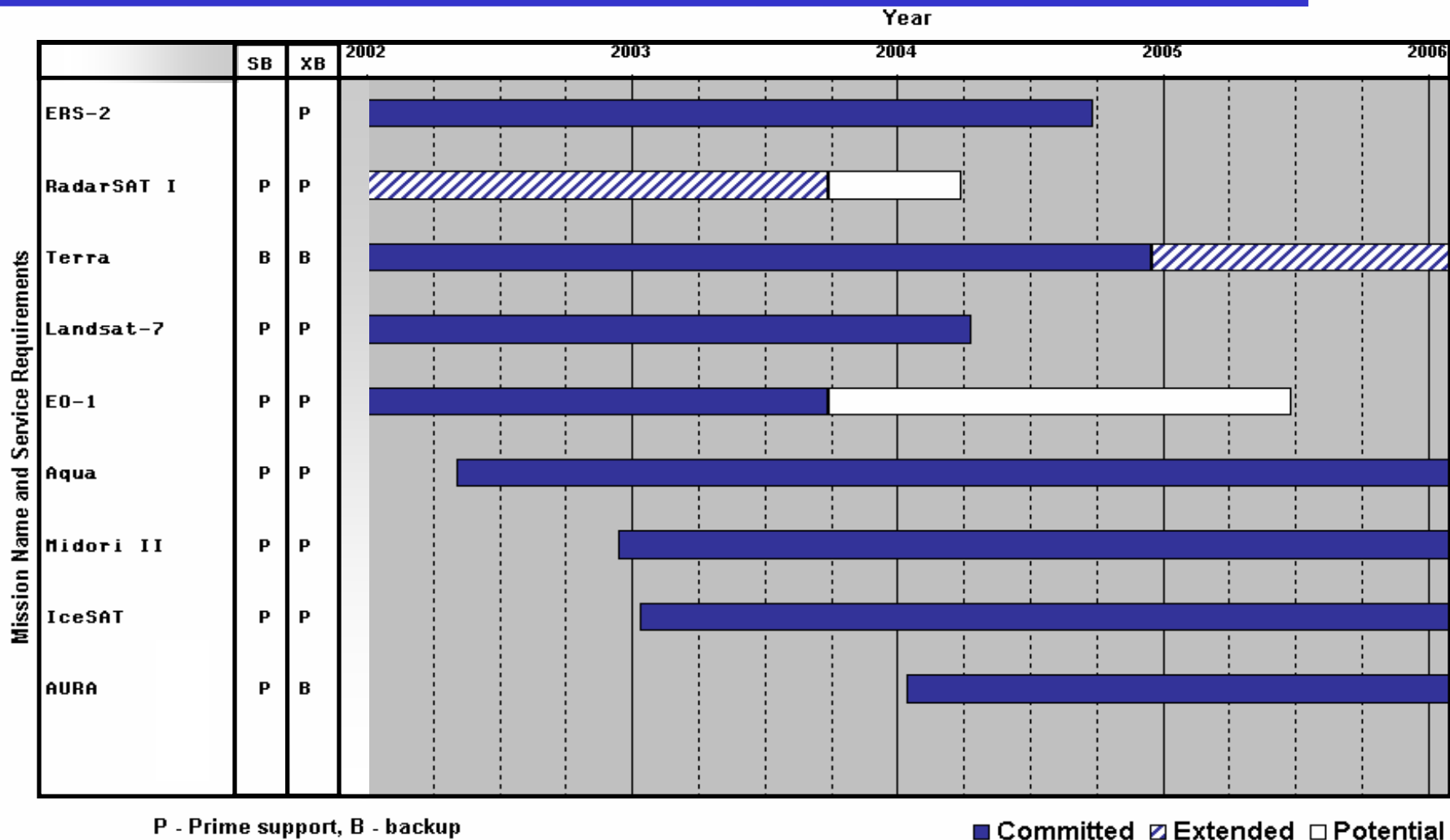
backup

GN Priorities

GROUND NETWORK

ABSOLUTE PRIORITY (APPLIES TO ALL PERIODS)

1. Emergency
   A. Human
   B. Spacecraft
2. STS Launch and Landing Support
3. ELV Launch Support
4. Critical Support
   A. Launch and Early Orbit Phase Support (Spacecraft)
      1) NASA Missions (including Cooperative)
      2) Non-NASA Missions
   B. Human
   C. Spacecraft Operations (e.g., maneuvers)
   D. STS Critical Pre-mission Testing and KSC Pad Testing
5. TDRSS
6. Normal Operations
7. Mission Testing
8. Scheduled Maintenance

http://www.wff.nasa.gov/~code452/prioritylist.html

GROUND NETWORK (GN) PRIORITES

1. A. STS Launch and Landing Support	21. TOMS-EP
B. ELV Launch Support	22. HESSI
2. TDRS-I	23. FAST
3. STS orbital support	24. SAMPEX
4. ISS	25. WIRE
5. TDRS-4	26. TERRA
6. TDRS-6	27. SNOE
7. PROSEDS	28. RADARSAT
8. ADEOS-2 (WGS ONLY) *	29. ERS-2
9. AQUA	30. SEAWIFS
10. LANDSAT-7	31. ASTRO-D
11. ADEOS-2	32. FUSE
12 QUIKSCAT	33. ERBS
13. JASON-1	34. KOMPSAT
14. TRACE	35. IMP-8
15. SWAS	36. GOES
16. EO-1	37. HELIOS
17. SAGE-III	38. IRS-P3
18. SAC-C	39. METEOSAT
19. GRACE-1/2	40. COBE
20. ACRIMSAT	41. LANDSAT-5

STATION / ANTENNA SC / BAND / SUPPORT	AGS 11	ASF 10	ASF 11	SGS 11	MGS 10	MGS MTRS	WPS 11	AGO 12/7	JHU/APL 5	JHU/APL 10	PF1 11	SAC/CSIR 10/6	SAC/CSIR 12.19/6	SKS 11	USN 13 ALASKA	USN 13 HAW	USN 13 DONGARA
Receive	SX	X	X	SX	SX	Data	SX	SX	SXL	SX	SX	SXL	SL	SX	SX	SX	SX
Command	S	-	-	S	S	Relay	S	S	-	L	S	S	S	S	S	S	S
Tracking	A D -	- - -	- - -	A D -	- - -	-	A D -	ADR	- - -	- - -	A D -	A - -	A - -	A D -	ADR	ADR	ADR
ADEOS-II (X) (Tlm)		Y 1,5,12,20	Y 1,5,12,20				Y 1,5,12,20										
AQUA (S & X) (TT&C)	Y 1,2			Y 1,2			Y1,16				Y 1,2			Y 1,2			
AURA (S & X) (TT&C)	Y1,2,20			Y1,2,20			Y1,16,20				Y1,2,20			Y1,2,20			
EO-1 (S & X) (TT&C)	Y 1,2,12,13			Y 1,2,12,13	Y1,10,11,12,13		Y 1,2,12,13				Y 1,2,12,13						
ERS-2 (X) (Tlm)		Y 1,5	Y 1,5				Y 1,5,10	Y									
ICESAT (S & X) (TT&C)	Y1,2			Y 1,2	Y1,11,20		Y1,16				Y 1,2			Y 1,2,20			
LANDSAT-7 (S & X) (TT & C)	Y1,2			Y1,2	Y11		Y11				Y1,2						
RADARSAT-1 (S & X) (Tlm & C)		Y1,5	Y1,5		Y2,25			Y									
TERRA (S & X) (TT & C)	Y1,2			Y1,2			Y1,11				Y1,2,20			Y1,2,20			
FAST (S) (TT&C)	Y7,12,20			Y7,12,14,20	Y7,11,12		Y7,12,14,20	Y7,12			Y7,12,14,20			Y7,12,14,20	Y7,12,14	Y7,12,14	Y7,12,14,20
GRAVITY PROBE B (S) (TT&C)	Y 1,12,20			Y 1,12,20	Y1,11,12,20		Y 1,12,20				Y 1,12,20			Y 1,12,20			
IMP-8 (VHF) (Tlm & C)																	
IRS-P3 (S) (Tlm)							Y1										
ISS (VHF VOICE)																	
JASON-1 (S) (Tlm & C)											Y8,12,14,15,20			Y8,12,14,15,20	Y8,12,14,15,20	Y8,12,14,15,20	Y8,12,14,15,20
METEOSAT-7 (L) (Tlm)																	
ORBVIEW-2 (S & L) (Tlm & C)							Y1,11										
Pro SEDS (S) (Tlm & T)							Y6,9	Y6,9								Y6,9,20	Y6,9,20
QUIKSCAT (S) (TT&C)	Y1,12			Y1,12	Y1,10,11,12		Y1,12				Y1,12			Y1,12,20			
SAGE III METEOR 3M-N1(L) (Tlm)																	
SAMPEX (S) (TT&C)	Y7,12,20			Y7,12,14,20			Y7,12,14,20	Y7,12			Y7,12,14,20			Y7,12,14,20	Y7,12,14	Y7,12,14	Y7,12,14,20
SNOE (Tlm & C)	Y12,20			Y12,20	Y10,12		Y12,20	Y12,20			Y12,20			Y12,20	Y12,20	Y12,20	Y12,20
SORCE (S) (Tlm & C)							Y6,8,12,14,20				Y6,8,12,14,20					Y6,8,12,20	Y6,8,12,20
SPACE SHUTTLE (S&UHF)(TTC&R)																	
SWAS (S) (TT&C)	Y7,12,20			Y7,12,14,20			Y7,12,14,20	Y7,12			Y7,12,14,20			Y7,12,14,20	Y7,12,14,20	Y7,12,14	Y7,12,14,20
TOMS-EP (S) (TTC & R)	Y19			Y19,20	Y11		Y19	Y17			Y19,20			Y19,20	Y17,20	Y17,20	Y17,20
TRACE (S) (TT&C)	Y7,12,20			Y7,12,14,20	Y7,11,12		Y7,12,14,20	Y7,12,20			Y7,12,14,20			Y7,12,14,20	Y7,12,14	Y7,12,14	Y7,12,14,20
WIRE (S) (TT&C)	Y7,12,20			Y7,12,14,20	Y7,11,12		Y7,12,14,20	Y7,12,20			Y7,12,14,20			Y7,12,14,20	Y7,12,14	Y7,12,14	Y7,12,14,20
YOHKOH (S) (Tlm)							Y6	Y6	Y6,20	Y6,20		Y6,20	Y6,20			Y6,20	Y6,20
ACRIMSAT (S) (TT & C)	Y			Y	Y11		Y	Y20			Y20			Y20	Y20	Y20	Y20
CHAMP (S) (TT&C)	Y12,13			Y12,13	Y12,13,20		Y12,13				Y12,13,20			Y12,13,20	Y12,13,20	Y12,13,20	Y12,13,20
ENVISAT (S) (TTC & R)																	
ERBS (S) (Tlm & C)	Y11,20						Y11,20	Y11,20			Y11,20	Y11,20	Y11,20		Y11,20	Y11,20	Y11,20
FUSE (S) (Tlm & C)																Y6,12,18	Y6,12,18,20
GOES 8-11 & M (S) (TTC & R)								Y6,17,20							Y6,17,20	Y6,17,20	
GOES N-Q (S) (TTC & R)								Y6,17,20							Y6,17,20	Y6,17,20	
GRACE 1-2 (S) (TT & C)	Y1,20			Y1,20	Y1,11,20		Y1,20				Y1,20			Y1,20			
HESSI (S) (Tlm & C)							Y6,12,13	Y6,12,13,20								Y6,12,13,20	Y6,12,13,20
LANDSAT 4 & 5 (S) (TTC & R)								Y6,17,20							Y6,17,20	Y6,17,20	Y6,17,20
QUIKTOMS (S) (Tlm & C)	Y12,13			Y12,13	Y12,13		Y12,13	Y12,13,20			Y12,13,20			Y12,13,20	Y12,13	Y12,13,20	Y12,13,20
SAC-C (S) (TT & C)	Y			Y	Y11		Y	Y20			Y20			Y	Y20	Y20	Y20
TDRS 1-8 (S) (TTC & R)								Y6,17,20,21							Y6,17,20,23	Y6,17,20,23	Y6,17,20,24

GN Reference Links

❑ GN home page - http://www.wff.nasa.gov/~code452/
  - Describes Station capabilities and mission priorities

❑ Space Network home page - http://msp.gsfc.nasa.gov/tdrss/
  - Links to description & capabilities

❑ Mission Set Database - http://Cserver.mii.instacontent.net
  - Mission set, customer commitment, launch forecast

❑ IPO Safety Net - http://npoess.noaa.gov/News/Maxi-2002/presentationList.html
  - NPOESS Program Overview

  - System Architecture & Performance

  - Space Segment

  - Ground Segments